SCOB ★ Q46 86-108099/17 ★EP-178-842-A

Repair system for power cable utility poles - includes excavating to allow fitting of multi-part sleeve around pole and filling of gap with non-shrinking hardenable cement

SCOTT BADER & CO LTD 16.10.84-GB-026085

X12 (23.04.86) E04h-12/22

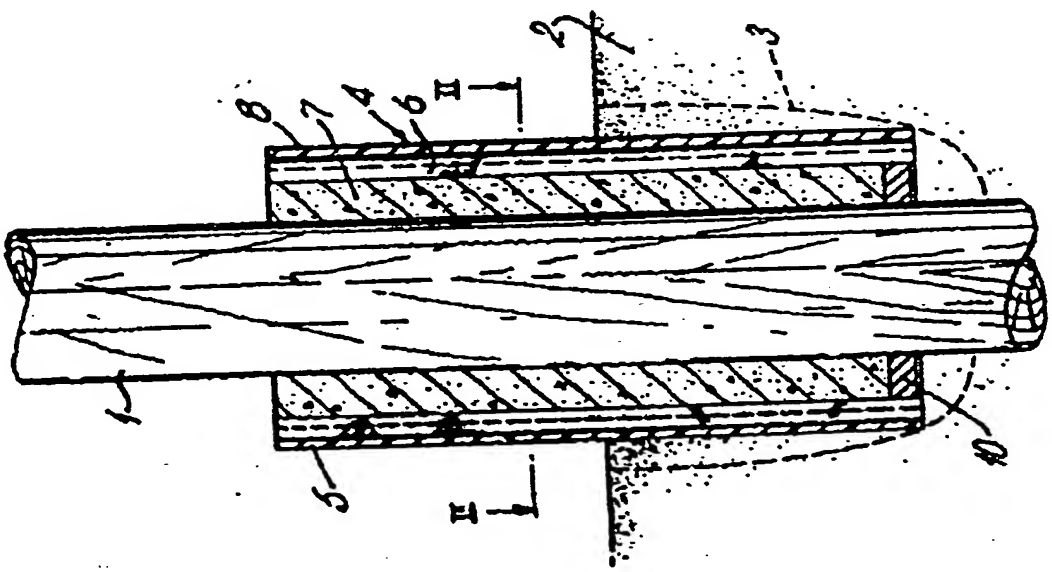
09.10.85 as 307214 (1460DH) (E) No-SR.Pub E(AT BE CH DE FR GB IT LI LU NL SE)

A metal sleeve (4) which is fabricated in two or more parts (5) and placed around the pole and the separate parts joined as by clips, bolts or other fitments to regain their strength and cylindrical integrity. Spacers may be fitted to maintain concentricity of pole and sleeve.

The gap between sleeve and pole is then filled with a non-shrinking hardenable material which bonds to the pole and the sleeve. This may be a magnesium phosphate cement or a cast filled resin. Preferably, the sleeve will extend from 1 metre below, to 1 metre above the ground.

USE/ADVANTAGE - Overhead power and communication lines. Applicable where rotting puts pole at risk, at or just above ground level where bending stresses from extreme weather conditions are greatest. (17pp Dwg.No.1/4)

N86-079622



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 178 842 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: 24.05.89

(51) Int. Cl.[4]: E 04 H 12/22

(21) Application number: 85307214.8

(22) Date of filing: 09.10.85

(54) **Repairing utility poles.**

(30) Priority: 16.10.84 GB 8426085

(43) Date of publication of application: 23.04.86 Bulletin 86/17

(45) Publication of the grant of the patent: 24.05.89 Bulletin 89/21

(84) Designated Contracting States: AT BE CH DE FR GB IT LI LU NL SE

(56) References cited:
US-A-2 897 553
US-A-3 390 951
US-A-4 306 821

(73) Proprietor: SCOTT BADER COMPANY LIMITED
Wollaston
Wellingborough Northamptonshire NN9 7RL (GB)

(72) Inventor: Phillips, Cecil Luther
The Moorings Vyse Road
Boughton Northamptonshire (GB)

(74) Representative: Harrison, David Christopher et al
MEWBURN ELLIS & CO 2/3 Cursitor Street
London EC4A 1BQ (GB)

Courier Press, Leamington Spa, England.

EP 0 178 842 B1

Description

Field of the invention

The invention relates to the in-situ repairing of utility poles.

Background of the invention

Utility poles are widely ued to support over-head power and telecommunication lines. Wooden utility poles are pressure impregnated before installation with materials such as creosote to minimise rotting but this still occurs, usually from the centre outwards.

The reasons for rotting usually are that

(a) the preservative does not penetrate to the centre of the poles; and

(b) some soils contain chemical compounds that are particularly aggressive even towards treated timbers.

Any rotting puts the poles at risk due to failure at or just above ground level where the maximum bending moment is applied. High bending stresses occur during extreme weather conditions and even new poles can be broken. For this reason poles which have lost more than 40% of their integrity (i.e. have a strength less than 60% of their original nominal strength) are replaced. This is not always easily accomplished as poles are often located in sites inaccessible to transport so that lengthy disruption of services can occur. Even though they may rot, wooden poles are still preferred in many parts of the world because of the availability of the wood (and they are comparatively easily climbed by a properly equipped workman). Alternatives to wooden poles such as reinforced concrete and glass reinforced plastics can also suffer damage at or about ground level.

The present invention is designed to provide a means and method for the in situ repair of utility poles.

Such a repair system to be viable should be capable of reinforcing poles to an acceptable strength equivalent to that of new ones, should be easy to accomplish on site, should need access only to the base of the pole so that there is no disruption of services, and should be resistant to corrosive and other attack so as to give a pole a long life without further maintenance.

Various systems for repairing elongate members have been proposed in the art.

For example, GB—A—1489518 shows a way of repairing piles underwater by cutting away a rotten part of the pile, surrounding it with a bag and pouring cement in the bag. The rotten part is effectively replaced by the concrete. The concrete, which may have a larger dimension than the original pile, is the only added load-bearing element. A small excavation may be made into the earth at the bottom of the pile and concrete may enter it, but it is not surrounded by the bag at that position. The purpose is to resist vertical loads.

GB—A—1550403 shows a way of strengthening structural tubes of an oil-rig by surrounding a damaged part by a sleeve, filling it under pressure with a hardenable composition and maintaining the pressure until the composition has hardened.

There have also been proposals for setting poles in their new condition into the earth and protecting them against rot; by filling a cavity in the earth with foam and setting the pole in it (GB—A—1199725); by forming a concrete pot in a cavity and then packing a pole into the pot with rubble or the like which is filled with a preservative (GB—A—429665); by setting them in a sleeve in the ground of which the upper end just projects from the surface (GB—A—433428); or by forming a solid protective layer on the pole before it is inserted into the ground (GB—A—125068).

In US—A—4306821, sleeve parts are spaced about a utility pole and used as a mould for an epoxy or the like filler which hardens around and bonds to the pole.

None of this prior art shows the present invention which is primarily concerned with the repair of utility poles at a region above and below ground-level.

According to the invention a kit for repairing in situ a utility pole projecting out of the ground comprise a rigid sleeve for positioning around the pole over a substantial length thereof in the region of the damaged portion of the pole usually at the transition from below-ground to above-ground, the inner periphery of the sleeve being spaced from the pole and a hardenable core material for placing in the space between the pole and the sleeve, and bonding to the pole characterized by the hardened material being at least mechanically bonded to the sleeve. The means may further include a stop for the bottom of the sleeve to prevent egress of the core material from that bottom.

The invention further provides a utility pole surrounded for a substantial length in its damaged portion by a composite comprising a hardened core surrounding and bonded to the material of the pole and hardened in situ between the pole and a sleeve surrounding the core to be at least mechanically bonded both to the pole and the sleeve.

Furthermore the invention provides a method of repairing utility poles comprising placing a sleeve around the pole and spaced from it over a substantial length of the pole at its damaged portion and filling between the sleeve and the pole with a hardenable core material and allowing the hardenable core material to harden. The material is selected to bond both to the sleeve and the pole. There must be at least a mechanical bond between all three elements (pole core and sleeve) to achieve the desirable results of the invention.

It can be seen that these expedients give a readily-usable in-situ repair capacity. The repaired pole has

three structural components in the repaired region; itself, the hardened core and the sleeve; the latter remaining as part of the finished assembly.

In all these aspects the sleeve may be a split sleeve being split lengthwise into two or more portions and being joinable together mechanically, adhesively or by both methods. Preferably it will be positioned so that it is approximately equally below and above ground (which will normally require excavation of the ground immediately around the pole).

A preferred clearance between the pole and the sleeve is between 10 and 75 mm all round. A preferred length for the sleeve is usually between 0.5 m and 3 m, which will usually be evenly shared between above and below ground portions of the pole. As a rule of thumb, the length of the sleeve should be the length of the damaged or rotted area plus 0.5 m.

During bending the principal stress is in the tensile plane, so the sleeve or its material may have highly directional (anisotropic) properties, i.e. high strength in the direction of the sleeve length. Such sleeves can be made from unsaturated polyester, vinyl ester or epoxide resins reinforced with glass, polyaramide, carbon or metallic fibres preferably running at least primarily in the direction of length of the sleeve. Pultrusion is one method of manufacture but other moulding processes can be used. Glass reinforced cement (GRC) and reinforced thermoplastics can also be used as the sleeve.

Isotropic materials which have equivalent strengths in the principal direction to the above anisotropic materials such as stainless and alloys, other corrosion resistant metals and coated metals can also be employed to make the sleeve.

To ensure good adhesion between core material and the sleeve the inner surface of the sleeve may be roughened and/or treated with a primer.

Likewise the surface of the pole should be treated before putting the sleeve in place to remove any loose material, dirt etc. and primed if necessary.

At the bottom of the sleeve there should be a unit which seals the orifice between the sleeve and the pole and this may at the same time locate the pole centrally to the sleeve. Alternatively, with some core materials the seal may be made with earth.

The core material can be a wide range of substances both inorganic and organic which fulfil two functions:

(a) bonding to both sleeve and pole, at least in the mechanical sense of cohering or adhering with them, and preferably forming a full physico-chemical bond.

(b) allow the load transfer from pole to sleeve when bending stresses are applied.

These core materials should be readily handleable on site, be usuable under varying weather conditions, have minimum, preferably zero, volume shrinkage, be of sufficiently low viscosity to fill cracks and fissures in the wooden pole, be pourable in stages without problems and be stable and weather resistant. Cure of the core to a crosslinked state should be rapid.

Among the suitable core materials are:—

Grouting cement formulated to give zero volume shrinkage.

Fast setting magnesium phosphate cements e.g. as described by Abdelrazig et al, British Ceramic Proceedings No. 35 September 84 pages 141—154.

High density urethane foam systems.

Cast thermoset resins with antishrink additives.

A particular embodiment of the invention and method of carrying it out will now be described with reference to the accompanying drawings wherein:

Figure 1 is a diagrammatic section through a utility pole about where it leaves the ground;

Figure 2 is a section on the line plane 2.2 of Figure 1,

Figure 3 shows an alternative on the same section; and

Figure 4 shows a test rig.

With reference to the drawings, a utility pole 1 may be a cylindrical wooden pole and has previously been set in the ground 2 by the digging or boring of a hole. If damage or attack has occured to the pole at or below ground level (which is the most common position for such damage, corrosion or rotting) it is repaired by the excavation around the pole of a small void (dotted lines 3) and the placing around it of a multipart sleeved construction 4. As seen in Figure 2 in the present embodiment this construction has two equal and identical halves 5 which can be clipped together by manual distortion of the sleeves, so that flange 6 is trapped by claw 8, each extending along respective edges of the half-sleeves. An alternative method of clipping the halves together is shown in Figure 3, with a U-strip 9 passed over the out-turned flanges 6′. At the bottom and indeed elsewhere on the sleeve may be spacers for maintaining a regular and desired spacing between the inner circumference of the sleeve parts and the pole. The appropriate spacing will depend on the dimensions of the pole and its expected loading. As seen in Figure 1, a ring 10 closed around the pole may act simultaneously as spacer and as a seal for the bottom of the sleeve.

A preferred length for the sleeve also depends on loading considerations but a standard length of 2 metres, of which 1 metre is intended to be below and 1 metre above ground will serve for most purposes.

Once placed the gap between the sleeve and the pole is filled with a hardenable core material 7 the general nature of which has already been discussed and which is to bond both to the pole and to the sleeve. The material is then left to harden in situ. The gap may be filled through an aperture in the flange 6 or in the wall of the sleeve parts 5, or from the top of the gap.

A roof element to prevent trapping of moisture on top of the sleeve may also be provided either integrally with the sleeve, or separately.

Example I

As a model a 19 mm wooden rod was tested to destruction to determine the strength. An equivalent rod was then bored out for 60 mm so that the strength was reduced to 60% of the original.

A glass reinforced polyester pultruded sleeve of 33 mm internal diameter and 2.5 mm wall thickness was placed around the bored-out end of the rod to cover 120 mm (equivalent to 2 m in a full scale situation). The gap between the rod and the sleeve was filled with non-shrink magnesium phosphate cement (6% water in paste) and allowed to cure for 3 days at room temperature.

The specimen was then supported in a specially designed jig to simulate loading at one end (e.g. wind loading on a power line) with the repaired end clamped at the equivalent of ground level i.e. 60 mm from the end. The free end was loaded until failure occurred. The failure occurred in the wooden rod beyond the repair i.e. outside the damaged zone indicating that the repair had restored the original properties of the rod. The load to failure was equivalent to that in the original undamaged rod.

Example II

Repairs were made on two full size poles A and B in which damage had been simulated by cutting V-notches at the position of maximum bending moment to simulate ground level damage. The V-notches were filled with foam of no significant mechanical strength to prevent ingress of cement into the V's. Glass reinforced plastic (GRP) sleeves were then fitted round each pole, each sleeve being 2 metres long and consisting of half-round sections 5 and fixed with GRP clips 8 which slid on flanges 6' as shown in Figure 3. The spacing from the pole was about 22 mm all round. The core material 7 was a non-shrink magnesium phosphate cement as described by Abdelrazig et al, *loc cit.*

Fourteen days after the repair was made the poles 1 were tested in a special rig in which they were held vertically on a support frame 11 by support straps 12 near the repaired end as shown in Figure 4. Dimension a is 0.5 m, b and c, 1 m. Loads were applied horizontally along arrow x at the undamaged end and the results obtained are shown in Table I. As can be seen the percentage of nominal strength attained was very high. In both cases the figure of 60%, which has been regarded as acceptable, was well exceeded, and similar successful results would be obtained using a minimal-shrink grouting cement or a minimal-shrink non-reinforced thermoset resin.

TABLE
Break test results

	Pole A	Pole B
Overall length of pole	9952 mm	9917 mm
Mid-position of sleeve from butt	1500 mm	1500 mm
Circumference (Mean) of the pole at 1.5 m from butt	755 mm	753 mm
Loading position distance from tip	80 mm	84 mm
Applied load kg	780 kg	880 kg
Applied load kN	7.65 kN	8.63 kN
Bending moment applied at 1.5 m from butt	64.04 kNm	71.91 kNm
Nominal (Theoretical Strength of normal new pole at 1.5 m from butt)	73.31 kNm	72.73 kNm
Percentage of Nominal Strength attained	87.35%	98.87%
Mode of failure	Complex	Complex

Claims

1. A method of repairing in situ a utility pole (1) projecting from the ground (2) the method including fitting a sleeve (4) around the pole (1);
filling a clearance between the sleeve and the pole with a flowable hardenable composition; and allowing the composition to harden to a core (7) characterized in that the flowable composition has at most minimum shrink and is when hardened bonded at least mechanically to the sleeve (4) and to the pole (1)
whereby the finished assembly comprises the sleeve (4) as a structural component.

2. A method according to Claim 1 which includes excavating the ground (2) around the pole (1) and fitting the sleeve approximately equally above and below ground-level.

3. A method according to Claim 2 wherein the excavation is to a depth of at least 0.25 m the sleeve is at least 0.5 m long and the clearance is between 10 and 75 mm.

4. A method according to any one of the preceding claims wherein the length of the sleeve is about 2 m.

5. A method according to any one of the preceding claims wherein the composition is a magnesium phosphate cement.

6. A method according to any one of Claims 1—5 wherein the composition is a cast thermoset resin with antishrink additives.

7. A method according to any one of the preceding claims wherein the sleeve is antisotropic, with high tensile resistance in the direction of its length.

8. A method according to any one of the preceding claims wherein the sleeve (4) comprises a plurality of identical parts (5), the parts being fitted together around the pole.

9. A repaired utility pole projecting upwardly from ground level and having a damaged region characterized in that a solid core (7) surrounds the damaged region of the pole (1) and is at least mechanically bonded thereto over its contact surface therewith; and
a sleeve (4) surrounds the core (7) and is at least mechanically bonded thereto over its contact surface therewith, whereby the sleeve is a structural component of the assembly.

10. A utility pole according to Claim 9 wherein the damaged region is around ground level and each of the core (7) and the sleeve (4) are approximately equally below and above the ground level.

11. A utility pole according to Claim 9 or Claim 10 wherein the core (7) is of magnesium phosphate cement.

12. A utility pole according to Claim 9, Claim 10 or Claim 11 wherein the sleeve (4) has a length along the pole (1) of about 2 m.

13. A utility pole according to any one of Claims 9 to 12 wherein the sleeve (4) is of a GRP material with its reinforcement running primarily along its length.

14. A utility pole according to any one of Claims 9—13 wherein the pole (1) is wooden.

15. A kit for the repair in situ of a damaged pole projecting upwardly from the ground comprising
a sleeve (4) for assembly around a damaged region of the pole in the vicinity of ground level to project into and out from the ground (2) and be spaced from the outer surface of the pole (1) and
a hardenable pourable composition characterized in that said hardenable pourable composition has at most minimum-shrink properties and is selected for bonding at least mechanically to both the sleeve (4) and the pole (1), so that the sleeve (4) is a structural component of the assembly.

16. A kit according to Claim 15 wherein the pole is wooden, the sleeve is of GRP and the composition is a magnesium phosphate cement.

Patentansprüche

1. Verfahren zur Reparatur eines Leitungsmastes (1), der aus dem Boden (2) hervorragt, an Ort und Stelle, das Verfahren umfassend
Anpassen einer Hülse (4) um den Mast (1);
Füllen eines freien Raumes zwischen der Hülse und dem Mast mit einer fließfähigen, aushärtbaren Zusammensetzung; und
Aushärtenlassen der Zusammensetzung zu einem Kern (7),
dadurch gekennzeichnet, daß die fließfähige Zusammensetzung höchstens eine minimale Schrumpfung aufweist und nach dem Aushärten wenigstens mechanisch an die Hülse (4) und den Mast (1) gebunden ist,
wodurch die fertiggestellte Einheit die Hülse (4) als strukturellen Bestandteil umfaßt.

2. Verfahren nach Anspruch 1, das das Ausheben des Bodens (2) um den Mast (1) herum und das Anpassen der Hülse annähernd zu gleichen Teilen oberhalb und unterhalb des Bodenniveaus umfaßt.

3. Verfahren nach Anspruch 2, worin der Aushub eine Tiefe von wenigstens 0,25 m aufweist, die Hülse wenigstens 0,5 m lang ist und der freie Raum zwischen 10 und 75 mm beträgt.

4. Verfahren nach einem der vorhergehenden Ansprüche, worin die Länge der Hulse etwa 2 m beträgt.

5. Verfahren nach einem der vorhergehenden Ansprüche, worin die Zusammensetzung ein Magnesiumphosphatzement ist.

6. Verfahren nach einem der Ansprüche 1 bis 5, worin die Zusammensetzung ein gegossenes wärmehärtendes Harz mit Antischrumpf-Zusätzen ist.

7. Verfahren nach einem der vorhergehenden Ansprüche, worin die Hülse anisotrop mit hoher Zugfestikeit in ihrer Längsrichtung ist.

8. Verfahren nach einem der vorhergehenden Ansprüche, worin die Hülse (4) eine Mehrzahl von identischen Teilen (5) umfaßt, wobei die Teile um den Mast herum zusammengefügt sind.

9. Reparierter Leitungsmast, der sich vom Bodenniveau nach oben erstreckt und einen beschädigten Bereich aufweist, dadurch gekennzeichnet, daß ein fester Kern (7) den beschädigten Bereich des Mastes (1) umgibt und wenigstens mechanisch daran über seine Berührungsfläche mit diesem gebunden ist;

und eine Hülse (4) den Kern (7) umgibt und wenigstens mechanisch an diesen über ihre Berührungsfläche mit ihm gebunden ist, wodurch die Hülse ein struktureller Bestandteil der Einheit ist.

10. Leitungsmast nach Anspruch 9, worin der beschädigte Bereich etwa auf Bodenniveau gelegen ist und der Kern (7) und die Hülse (4) jeweils etwa zu gleichen Teilen unter und über dem Bodenniveau angeordnet sind.

11. Leitungsmast nach Anspruch 9 oder 10, worin der Kern (7) aus Magnesiumphosphatzement besteht.

12. Leitungsmast nach Anspruch 9, 10 oder 11, worin die Hülse (4) ein Länge entlang des Mastes (1) von etwa 2 m aufweist.

13. Leiktungsmast nach einem der Ansprüche 9 bis 12, worin die Hülse (4) aus einem GRP- bzw. GFK-Material besteht und sich ihre Verstärkung vorwiegend entlang ihrer Länge erstreckt.

14. Leitungsmast nach einem der Ansprüche 9 bis 13, worin der Mast (1) aus Holz besteht.

15. Werkzeugsatz bzw. Ausrüstung für die Reparatur eines beschädigten Mastes, der aus dem Boden nach oben hervorragt, an Ort und Stelle, umfassend

eine Hülse (4) für das Zusammenfügen um einen beschädigten Bereich des Mastes nahe des Bodenniveaus um in den Boden (2) hinein und aus dem Boden herauszuragen und im Abstand von der Außenfläche des Mastes (1) angeordnet zu werden; und

eine aushärtbare, vergießbare Zusammensetzung,

dadurch gekennzeichnet, daß die genannte aushärtbare, vergießbare Zusammensetzung höchstens Minimum-Scrumpfungseigenschaften besitzt und gewählt wird, um wenigstens mechanisch sowohl an die Hülse (4) als auch dem Mast (1) zu binden, sodaß die Hülse (4) zu einem strukturellen Bestandteil der Einheit wird.

16. Satz nach Anspruch 15, worin der Mast aus Holz besteht, die Hülse aus GRP bzw. GFK besteht und die Zusammensetzung ein Magnesiumphoshatzement ist.

Revendications

1. Procédé pour réparer sur place un pylône (1) émergeant du sol (2), comportant:

le placement d'un manchon (4) autour du pylône (1);

le remplissage d'un intervalle entre le manchon et le pylône avec une composition fluide durcissable; et

le fait de laisser durcir la composition de remplissage pour qu'elle forme un noyau (7), le procédé étant caractérisé en ce que la composition fluide a tout au plus un retrait minimal et que, lorsqu'elle est durcie, elle se lie au moins mécaniquement au manchon (4) et au pylône (1),

l'assemblage fini comprenant le manchon (4) comme composant structurel.

2. Procédé selon la revendication 1, dans lequel on creuse un fosse dans le sol (2) autour du pylône (1) et on installe le manchon de manière que sa partie enterrée soit environ aussi longue que sa partie émergeante.

3. Procédé selon la revendication 2, dans lequel la fosse a une profondeur d'au moins 0,25 m, le manchon a une longueur d'au moins 0,5 m et l'intervalle a une dimension de 10 à 75 mm.

4. Procédé selon l'une des revendications précédentes, dans lequel la longueur du manchon est d'environ 2 m.

5. Procédé selon l'une des revendications précédentes, dans lequel la composition de remplissage est un ciment au phosphate de magnésium.

6. Procédé selon l'une des revendications 1 à 5, dans lequel la composition de remplissage est une résine thermodurcissable coulée contenant des additifs anti-retrait.

7. Procédé selon l'une des revendications précédentes, dans lequel le manchon est en un matériau anisotrope possédant une grande résistance à la traction dans son sens longitudinal.

8. Procédé selon l'une des revendications précédentes, dans lequel le manchon (4) comporte une pluralité de parties identiques (5), ces parties étant assemblées entre elles autour du pylône.

9. Pylône réparé émergeant verticalement du sol et ayant une zone endommagée, caractérisé en ce qu'un noyau solide (7) entoure la partie endommagée du pylône (1) et est liée au moins mécanique avec ce pylône sur sa surface de contact avec lui; et

qu'un manchon (4) entoure le noyau (7) et est lié au moins mécaniquement avec ce noyau sur sa surface de contact avec lui, le manchon étant un composant structurel de l'ensemble.

10. Pylône selon la revendication 9, dans lequel la zone endommagée se trouve dans le voisinage du

niveau du sol et le noyau (7) et le manchon (4) ont des longueurs environ égales dans le sol et au-dessus du sol.

11. Pylône selon la revendication 9 ou 10, où le noyau est en ciment au phosphate de magnésium.

12. Pylône selon la revendication 9, 10 ou 11, dans lequel le manchon (4) a une longueur d'environ 2 m le long du pylône (1).

13. Pylône selon l'une des revendications 9 à 12, dans lequel le manchon (4) est en un matériau plastique renforcé de fibres de verre dont le renforcement se trouve en substance dans le sens longitudinal.

14. Pylône selon l'une des revendications 9 à 13, dans lequel le pylône (1) est en bois.

15. Système pour la réparation sur place d'un pylône endommagé émergeant verticalement du sol, comprenant

un manchon (4) à assembler autour d'une partie endommagée du pylône dans le voisinage du niveau du sol, pénétrant dans le sol (2) et en émergeant, et se trouvant à distance de la surface extérieure du pylône (1) et

une composition durcissable coulable, le système étant caractérisé en ce que ladite composition possède tout au plus des propriétés de retrait minimal et est choisi telle qu'elle se lie au moins mécaniquement au manchon (4) ainsi qu'au pylône (1), de sorte que le manchon (4) est un composant structurel de l'ensemble.

16. Système selon la revendication 15, dans lequel le pylône est en bois, le manchon en plastique renforcé de fibres de verre et le produit de remplissage un ciment au phosphate de magnésium.

Fig.1.

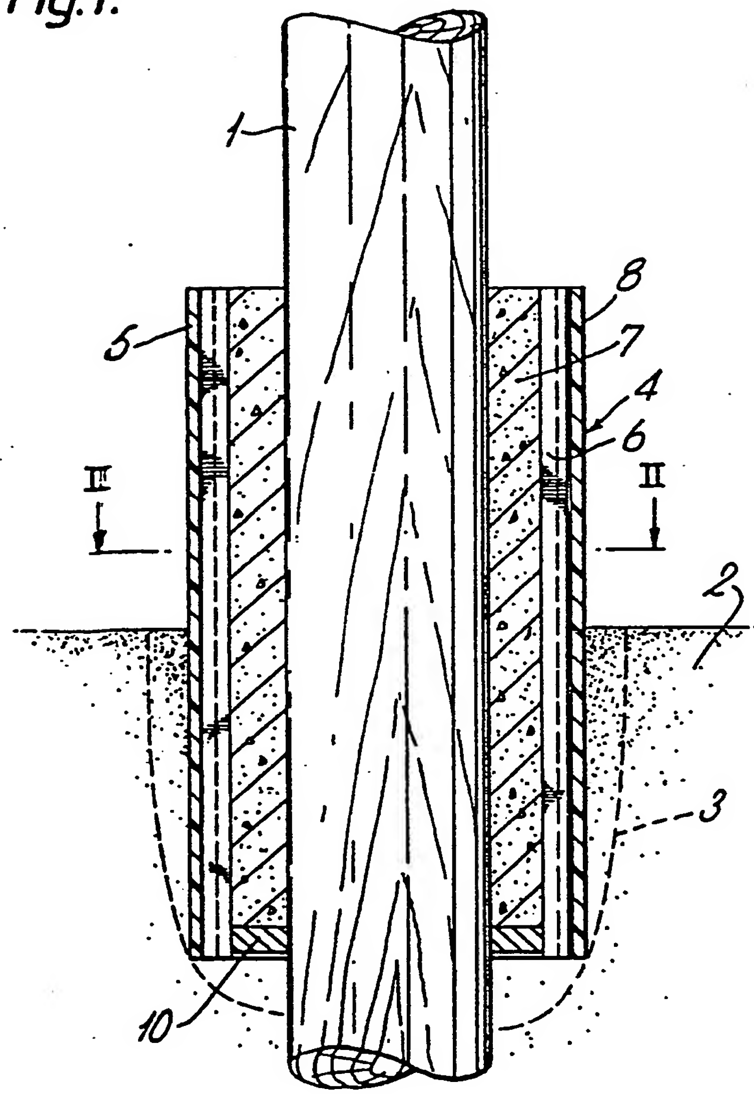


Fig. 2.

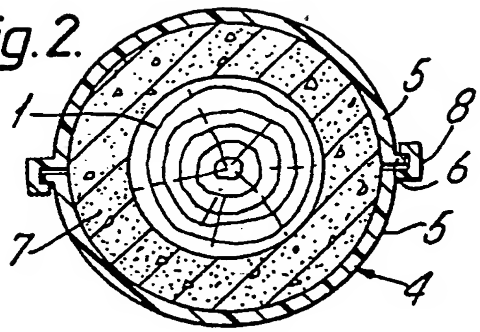


Fig. 3.

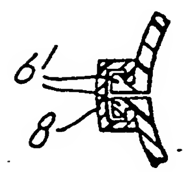


Fig. 4.